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Finland's National Genetic Resources Programme for Agriculture, Forestry and Fishery

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Finland's National Genetic Resources Programme for Agriculture, Forestry and Fishery

Summary of the Finland's National Genetic Resources Programme for
Agriculture, Forestry and Fishery

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Abstract	<p>The National Genetic Resources Programme revises and updates the earlier National Plant and Animal Genetic Resources Programmes (MMM 2001 and MMM 2004). The Programme, prepared in cooperation between the Ministry of Agriculture and Forestry and Natural Resources Institute Finland, covers the genetic resources of cultivated plants, domesticated animals, forest trees and fish.</p> <p>The Programme provides the guidelines for the preservation, conservation and sustainable use of genetic resources. During the preparation process decisions on the content and priorities of the Programme were guided by the changes in the operating environment, reflected in strategies and policies concerning the conservation and sustainable use of genetic resources.</p> <p>The implementation of the Programme is coordinated by the Natural Resources Institute Finland (Luke). Genetic resources are being conserved by several public and private operators, of which the Natural Resources Institute Finland has the most significant role.</p> <p>The National Advisory Body for Genetic Resources functions as the expert body of the Ministry of Agriculture and Forestry in preparing matters relating to the conservation and sustainable use of genetic resources.</p> <p>Its tasks include development and monitoring of the Programme, preparation of strategies and policies.</p>		
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Referat	<p>Med hjälp av det Nationella genresursprogrammet förnyas tidigare Nationella program för växtgenetiska och djurgenetiska resurser (JSM 2001, JSM 2004). Genresursprogrammet omfattar genetiska resurser för kulturväxter, husdjur, skogsträd och fiskar. Genresursprogrammet har utarbetats av jord- och skogsbruksministeriet och Naturresursinstitutet.</p> <p>Genresursprogrammet styr förvaring, bevarande och hållbart nyttjande av genetiska resurser. I utarbetandet av det nationella genresursprogrammet har innehållet och tyngdpunkterna i programmet styrts av förändringar i verksamhetsmiljön och de strategier för skydd och hållbart nyttjande av naturresurser som återspeglar dem.</p> <p>Genresursrådet som lyder under JSM övervakar och Naturresursinstitutet (Luke) koordinerar verkställandet av Genresursprogrammet. Uppgifterna omfattar strategiska riktlinjer och lagstiftningsberedning och utveckling och övervakning av program för genetiska resurser.</p> <p>Genresursrådet för genetiska resurser fungerar som jordbruks- och skogsbruksministeriets expertorgan för att förbereda frågor som rör bevarande och hållbar användning av genetiska resurser. Dess uppgifter omfattar utveckling och övervakning av programmet, utarbetandet av strategier och politik.</p>		
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1 INTRODUCTION

The genetic resources for agriculture and forestry are a significant part of biodiversity both ecologically and financially. The primary purpose for conserving these resources is to retain the ability to develop cost-effective and sustainable ways of using natural resources and improve of the quality of the final products. This includes employing plant, forest and animal breeding to prepare for changes that will occur in our agriculture and forestry. The genetic resources for agriculture and forestry comprise the genomes of modern plant varieties and indigenous varieties and their wild relatives, domestic animal breeds, fish and forest trees. They represent the 'raw material' for plant and animal breeding.

Protection of genetic resources is an extremely long-term effort that is closely tied to the national preparedness for crises and risks. It also forms the basis for business in agriculture and forestry and enables its further development. As a result, genetic resources are a component of the security of supply.

Genetic resources also represent culturally and historically valuable heritage and are an important part of the national memory and history of agriculture.

The legal basis for the protection of genetic resources and their sustainable use are international treaties: the Convention on Biological Diversity, CBD, 1993, SopS 78/1994 and its supplement, the Nagoya protocol (2014), the International Treaty on Plant Genetic Resources for Food and Agriculture, IT-PGRFA, SopS 90/2004 and the FAO action plans: the Second Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture, GPA, 2011; the Global Plan of Action for Farm Animal Genetic Resources, 2007 and the First Global Plan of Action for Forest Genetic Resources, 2013. At national level, the conservation and sustainable use of natural resources is also governed by national and EU legislation and strategies.

Finland implements the international agreements through national genetic resources programmes. The national plant genetic resources programme for agriculture and forestry (MOAF 12/2001) covers the genetic resources in agriculture, horticulture and forestry. The Finnish animal genetic resources programme (MOAF 17/2004) covers both indigenous

breeds of domestic animals and imported breeds having a long breeding history in Finland. The programmes present the key principles and objectives for the conservation and sustainable use of genetic resources, including suggested actions. The coordination of the programmes is assigned to the Natural Resources Institute Finland.

National genetic resources programmes have formed the basis for the establishment of national genetic resources collections and the organization of work on genetic resources at national and Nordic level. Throughout the operations, research has been an integral part of the development of the conservation of genetic resources and sustainable use.

1.1 Revision of the genetic resources programmes

Since the creation of national genetic resources programmes, the operating environment in which agriculture and forestry is practised has changed in many ways.

Of all environmental changes taking place at the global level, climate change, loss of biodiversity and the increased consumption of natural resources in particular weaken the ecosystem services which represent the foundation for the existence of living organisms and humanity. The effects of these changes also harm the environments in which agriculture, forestry and fishing are practised. The rapid pace of the changes requires that agriculture, forestry and fisheries adapt rapidly to the new circumstances. The genetic resources for agriculture, forestry and fisheries play a key role in this.

The socioeconomic environment has also changed. Consumer choice demonstrates a greater awareness of environmental values and sustainable use of natural resources, especially with regards to food. Organic production, locally sourced foods and the origin of food steer modern consumer choice, even if the choices increase the price of food.

The changes described above are also reflected in the strategies that guide the sectors. The themes in the current strategies that guide the administrative branch are conservation of biodiversity, adaptation to climate change and mitigating its adverse effects, and developing a bioeconomy based on the sustainable use of renewable resources and food security. An overarching theme in the strategies is holistic thinking that seeks to integrate natural resources, climate, energy and biodiversity into a comprehensive whole that is strongly linked to the entire society. The upcoming programme period will also develop collaboration models that will enhance the implementation of the national genetic resources programme and the Åland Islands genetic resources programme.

The first national animal genetic resources programme does not extend to fish genetic resources. The decline in fish populations due to environmental changes requires increasing efforts to conserve fish genetic resources, which is clearly stated in the action plan for biodiversity and sustainable consumption of natural resources 2013–2020. FAO is also stepping up its operations on conserving fish genetic resources and sustainable use, with a short-term objective of creating a State of the World report on aquatic genetic resources. The increased need to conserve fish populations and the growing importance of fish as food require that the conservation and sustainable use of fish genetic resources are organized into a unified fish genetic resources programme.

The objectives and actions pertaining to sector-specific conservation of genetic resources and their sustainable use were based not only on legislation, but also on the changes occurring in the operating environment, with a special emphasis on the characteristics of the Finnish environment.

1.2 Description of the contents of the national genetic resources programme

The national genetic resources programme revises the previous national programmes on plant and animal genetic resources (MOAF 2001, MOAF 2004). The national plant and animal genetic resources programmes formed the foundation for systematic conservation and maintenance of genetic resources. The primary purpose of the programmes was to collect and organize genetic resource collections. The changes in the operating environment and the associated strategies on the conservation and sustainable use of natural resources have had a greater effect on the content and foci of the new genetic resources programme. The new programme is designed to serve as a guideline for actions for approximately ten years, after which it must be assessed and revised.

The genetic resources programme covers the genetic resources of cultivated plants, domestic animals and fish as separate sectors.

The programme guides the conservation, protection and sustainable use of genetic resources. An advisory board on genetic resources acts as the MOAF expert body in the preparation of matters associated with the conservation and sustainable use of genetic resources. The board creates strategic policies, prepares laws, develops and monitors programmes on genetic resources, acts as a discussion forum among stakeholders and also acts as a body that prepares Nordic and international matters. The Natural Resources Institute Finland coordinates the execution of the genetic resources programme.

The conservation of genetic resources is distributed across several public and private organizations, of which the Natural Resources Institute Finland is the most important.

The conservation of genetic resources consists of the identification of national genetic resources in agriculture, forestry and the fishing industry and their maintenance in genetic resource collections and in their natural habitats. The conservation prioritises genetic resources that express properties that can be used in plant and animal breeding to adapt cultivated plants, domestic animals and fish populations to ongoing environmental changes, particularly climate change. With regards to forest trees, the programme emphasises the significance of diversity over individual characteristics in the ability to adapt. One of the justifications for conserving genetic resources is their heritage value.

The genetic resources programme promotes the sustainable use of genetic resources primarily through research and development projects. Plant and animal breeding are promoted by researching the properties expressed by the genetic resources. Business based on indigenous varieties of cultivated plants and domestic animals is also promoted by research and development projects, advice and communications in collaboration with other organizations in the field.

1.3 Working group

The genetic resources programme was created by a working group consisting of the following members: Chairperson of the advisory board on genetic resources, Ministerial Adviser Tuula Pehu from the Ministry of Agriculture and Forestry (coordination) and coordinators of genetic resource programmes, Senior Researcher Elina Kiviharju, Professor Juha Kantanen, Senior Researcher Mervi Honkatukia, Senior Specialist Mari Rusanen and Principal Specialist Petri Heinimaa from the Natural Resources Institute Finland.

Other experts included, but were not limited to, Researcher Sirkka Juhanoja from the Natural Resources Institute Finland (plants for urban landscaping), Researcher Terhi Suojala-Ahlfors (vegetables, herbs and medicinal plants), Researcher Jaana Laamanen (fruit and berry plants, plant health), Researcher Maarit Heinonen (*in situ* conservation, cultural history), Researcher Merja Hartikainen (databases, genetic resource parks), Researcher Anna Nukari (cryopreservation of horticultural plants), Senior Researcher Marja-Liisa Koljonen (genetic diversity in fish), Specialist Leena Yrjänä, Researcher Pekka Vakkari and Professor Katri Kärkkäinen (forest genetic resources), and Researcher Heli Fitzgerald from the University of Helsinki, Finnish Museum of Natural History, (conservation of wild relatives of cultivated plants).

2 OBJECTIVES OF THE NATIONAL GENETIC RESOURCES PROGRAMME

The objectives of the genetic resources programme are based on the strategies and action plans that guide the administrative branch. The primary goal is to promote the adaptation of agriculture, forestry and fisheries to the changes taking place in their operating environments. The sector-specific objectives complement the general objectives of the programme.

General objectives of the genetic resources programme:

Conservation of the genetic diversity of biological natural resources and primary production

The changes taking place in the production environments of the agricultural, forestry and fisheries sectors have the strongest impact on primary production. The central production inputs in primary production are the genetic resources in agriculture, forestry and the fishing industry. As the production environment is undergoing rapid and partially unpredictable changes, it is of paramount importance to secure the availability of diverse genetic resources. This can only be achieved by fostering extensive genetic diversity by means of *ex situ* and/or *in situ* conservation for all production sectors.

The geographical location of Finland results in unique characteristics of our genetic resources, which obligates us to conserve them.

Adapting agriculture, forestry and fisheries to environmental changes, in particular climate change

The primary justification for the conservation of genetic resources in agriculture, forestry and fisheries is to retain the ability to breed plants and animals in preparation for the changes that are taking place in the operating environments of agriculture, forestry and

fisheries. Breeding links the availability, conservation and use of genetic resources to food security and security of supply on a national scale.

The conservation of agricultural and forest genetic resources has become increasingly important due to climate change. Climate change has a profound effect on all sectors of agriculture, forestry, fisheries and the natural environment. Controlled adaptation of primary production to the changing conditions depends on the availability of sufficient genetic diversity and different properties that can be used as required in plant and animal breeding. This requires an increased investment in the description and evaluation of genetic resources and a closer alignment between the objectives of the conservation of genetic resources and their use.

Developing business associated with the use of genetic resources

The conservation of genetic resources can also be supported by promoting market-based conservation of genetic resources. This allows society to expand its responsibility for the conservation of genetic resources and improve the cost-effectiveness of the conservation.

The special characteristics of indigenous varieties and breeds form a solid basis for the commercialisation of plant and animal genetic resources. Furthermore, special products based on genetic resources represent a good match with the values of modern citizens and consumers. However, creating conditions for successful business based on agricultural genetic resources still needs a lot of work. Quality factors built on genetic resources are still poorly understood and the product and service chains do not work.

The genetic resources programme can promote business based on genetic resources by targeted R&D projects that seek to solve problems in commercialisation as well as by providing advice and information in collaboration with the stakeholders in the sector.

Conserving the cultural heritage associated with genetic resources

A component of the diversity of plant and animal genetic resources is their heritage value. They are a part of our living cultural heritage and thus worth conserving. The resources reflect the past cultivation and breeding history of landraces and the culinary values of the past.

Information collected from the history of landraces can also be used in the marketing of products made from them. The collection of information on landraces and old varieties and breeds is also important in order to support the cultivation and continuity of native plants, old varieties and native animal breeds.

Integration of the objectives of the genetic resources programme with the strategies of the administrative branch

The genetic resources policy of the ministry is not defined as a separate entity at the strategic level, even though the conservation of genetic resources has been taken into account in the strategies and action plans of various sectors. This has reduced the weight of genetic resources conservation in the natural resources policy of the administrative branch. In particular, the changes taking place in the agricultural and forestry environment increase the strategic importance of the genetic resources policy in the adaptation to these new conditions. Therefore, the link between the work on genetic resources conservation and strategic guidance must be strengthened, for example by creating guidelines on genetic resources policy. The revision of the genetic resources programme seeks to connect the genetic resources programme to the implementation of the natural resources policy of the administrative branch at all levels.

Strengthening the communications on the conservation and sustainable use of genetic resources

To meet the objectives of the revision of the genetic resources programme – which are to couple the programme more tightly to the implementation of the natural resources policy and to extend the responsibility for the conservation of genetic resources to the private and third sector – requires that the decision-makers and citizens be more aware of the conservation and use of genetic resources.

Genetic resources are a concept that is somewhat difficult to comprehend. As a result, experts, officials and NGOs play an important role in making the concept more comprehensible. The objective must be to communicate clearly the practical importance of the conservation and use of genetic resources for agriculture, forestry, fisheries, the environment and citizen well-being. To increase the effectiveness of communications requires communication that is wide-ranging and diverse in terms of its content, target groups, methods and channels.

3 ACTION PLAN – SUMMARY

3.1 Cultivated plant genetic resources

Current state and priorities

The aim of the national plant genetic resources programme is to secure in the long term the genetic diversity of cultivated plants and enhance their sustainable use in Finland. The plant genetic resources programme covers the field crops and horticultural plants cultivated in Finland. In addition to food and feed plants, the programme also covers herbs, medicinal plants, ornamentals and landscaping plants. A new area is the conservation of the crop wild relatives which will be planned in collaboration with the environment sector. The plant material selected for long-term conservation is known to be genetically and regionally diverse and well-adapted to Finland's northern growing conditions.

The plant genetic resources programme makes inventories, characterizes and maintains the genetic diversity of cultivated plants and stores information related to genetic resources; promotes the safe conservation, evaluation, accessibility and sustainable use of genetic resources; promotes education, advice and general awareness on plant genetic resources; and takes care of the national and international administrative expert tasks associated with plant genetic resources in its area of operations. The national plant genetic resources programme is coordinated by the Natural Resources Institute Finland.

The most important agreements and strategies

The operations of the plant genetic resources programme implement the general objectives agreed in international agreements. The most important agreements are the Convention on Biological Diversity (CBD, 1992), the International Treaty on Plant Genetic Resources for Food and Agriculture (IT-PGRFA, 2004) and the Global Plan of Action for Plant Genetic Resources for Food and Agriculture (GPA, 1996, 2011). In addition, the objectives of the plant genetic resources programme are linked with many national and international strategic plans on natural resources, such as the EU Biodiversity Strategy

2020, the Action Plan for the Conservation and Sustainable Use of Biodiversity in Finland 2013–2020, implementation of the Aichi biodiversity targets 2020 and the UN sustainable development goals 2030 and the goals for addressing locality in the national food strategy 2030.

Conservation

The genetic resources of cereals, forages, legumes, oil crops and potato are conserved in the Nordic Genetic Resource Centre (NordGen) in Sweden. The conservation of seed samples is ensured by storing the safety copies in the Svalbard Global Seed Vault (SGSV). Experts from the national plant genetic resources programme participate in NordGen's plant group meetings, organizing the conservation of genetic resources.

The primary location for conserving vegetatively propagated field crops and horticultural species is the Natural Resources Institute Finland, which has the required expertise, fields, greenhouses and laboratories, as well as the equipment and information systems for managing the collections and maintaining the variety authenticity and plant health. Establishment of backup collections required by good genebank practices, and collections of ornamental plants with a wide range of species is distributed, if possible, to the third sector and private sector, utilizing the incentive in the rural development programme. The plant genetic resource collections of the Åland Islands are located in the Jomala research station. Collaboration with the Åland Island government will be increased.

The conservation of vegetatively propagated species is backed up in a cryobank in the Natural Resources Institute Finland. The cryopreservation enables storage of plants in limited storage facilities protected from pests with minimum need for maintenance and at low risk. Cryopreservation will be used increasingly as a conservation method.

In the first phase of the plant genetic resources programme work, the plant genetic resource material held in the research centre was inventoried, and the public plant callings were made to establish the missing diversity. On the basis of the genetic and phenotypic analyses and the cultural history knowledge, the plant varieties were selected for inclusion in the national long-term conserved collection, and the conservation is organized in the Natural Resources Institute Finland. Some material is still awaiting for more detailed evaluation and a final decision on a conservation mandate. In particular, ornamental plants include groups where collection and conservation has not yet been arranged.



Photo 1. In the field collections, the cultivation and utilization potential of plant varieties can be evaluated, and valuable genetic resources conserved. The photo shows a field experiment of fruit trees at Luke Piikkiö. Photo by Elisa Uusirasi, Luke

The information systems used by the national plant genetic resources programme will be developed according to the needs of the national management of the genetic resources collections. Information on the plants in the national genetic resource collections will be added to the NordGen's database, and they will become a part of the international genebank system and the European virtual gene bank AEGIS (A European Genebank Integrated System), which Finland joined in 2010. The genetic resources programme experts work actively in the European network for plant genetic resources, which promotes collaboration among the national genetic resources programmes.

Sustainable use and accessibility

Plant breeding and research on genetic resources promotes the adaptation of agriculture and horticulture to climate change, and consequently ensures food security and security of supply. The purpose of the work on plant genetic resources is to ensure that the diversity of cultivated plants is available for sustainable use purposes, such as breeding of cultivars, research aims and commercialisation. In order to utilize plant genetic resources more efficiently, greater contribution needs to be focused on analysis of utilization potential. In addition, more means of promoting the financial viability of products based on local genetic resources need to be developed and sales activities that promote the

maintenance of genetic resources encouraged. The use of landraces and old cultivars ensures that they remain under cultivation. Cultivation subsidy for landraces should be continued and developed further because it encourages cultivation of these varieties. To enhance the product marketing, the information collected on the origin and history of the plant varieties can be used.

The International Treaty on Plant Genetic Resources for Food and Agriculture (IT-PGRFA) agrees on the accessibility and the fair and equal benefit-sharing resulting from the use of plant genetic resources for food and agriculture. The Finnish Act implementing the Nagoya Protocol that supplements the CBD does not contain a proposal on the regulation of the availability of domestic genetic resources.

NordGen acts as an active genebank through which the seeds of cultivated plants are available for research, breeding and education purposes, and also to hobbyists when possible. The best fruit, berry and ornamental plants of the national plant genetic resources collections have been released on to the market as evaluated, healthy and unique FinE, Finnish Elite plants. The continuation of this operation is important as it increases accessibility to the plant genetic resources.

The plant genetic resources collections conserved in the Natural Resources Institute Finland are public, but not open, and are not generally available yet. The procedures for material transfer agreements and practices to arrange access to the plant material need to be developed. Availability should be organized primarily via certified production. As part of this process, standard operating procedures are written on the management of plant diseases and pests specified in the legislation on plant health.

Organizations such as Maatiainen ry, Hyötykasviyhdistys ry and many nurseries have made important contributions to the maintenance of the diversity of old varieties of cultivated plants and facilitating their availability.

Research

Many national and international research projects have promoted the collection, evaluation and conservation of the genetic resources of various plant groups, including the development of conservation methods and databases. This work must continue. It is important to strengthen evaluation of the characteristics of plant genetic resources because this information provides users with knowledge of the breeding, genetic, economic and social value of the genetic resources. Genetic identification methods should be developed for new species and use of them for diversity analyses, rationalisation of the collections and identification of cultivars, mapping of genetic alleles and understanding genetic adaptation mechanisms and the genetic basis of breeding characteristics. More

investments are needed for the development of conservation methods: in particular, the development of cryopreservation methods for new groups of species should be continued because severe plant health problems have been encountered in field collections in recent years. Research is also needed for the data management of the distributed collections, as well as to organize the conservation of crop wild relatives of cultivated plants. Parks that display plant genetic resources should be developed and used to a greater extent to promote tourism and awareness of genetic resources. It is also important to enhance understanding of genetic diversity of cultivated plants as part of sustainable development education.

3.2 Forest tree genetic resources

Current state and priorities

The primary objective of the work on genetic resources of forest trees is to conserve the intraspecific genetic diversity because the ability of a species to adapt to changing circumstances via natural selection is based on diversity. Genetic variation is conserved in gene reserve forests and genetic resource collections in a way that keeps the level of variation high without the need to maintain specific individual genotypes.

The programme lays out the need for conservation and primary methods for a total of 19 tree species; conservation is proposed for almost all financially or ecologically important tree species in Finland. The material to be conserved covers the existing adaptations to the different climate types in mainland Finland. Conservation of genetic diversity takes place either at the original location (*in situ*) in the environment in which the population developed its characteristics or outside the original location (*ex situ*). The selection of methods for each species is based on general knowledge of the reproductive biology and other properties of the species. The most important properties are the extent and continuity of the distribution area, abundance of flowering, efficiency of the spread of pollen and seeds and the abundance/rarity of the species in Finland.

The most important agreements and strategies

Internationally, the most important programmes that support and guide the work on forest genetic resources are the FAO Global Plan of Action for the conservation, sustainable use and development of forest genetic resources, the Convention on Biological Diversity and the FOREST EUROPE process, the obligations of which are met both at the national level and via collaboration through the EUFORGEN programme. Nordic collaboration takes place within NordGen. The most important national programmes are Forest Strategy

2050, The National Climate Change Adaptation Plan 2022 and the Action Plan for the Conservation and Sustainable Use of Biodiversity in Finland 2013–2020.



Photo 2. Cuttings of pillar juniper beautifully reproduce the habit of the original specimen. Juniper genetic resources collection 220 (Paimio, Preitilä). Photo by Erkki Oksanen, Natural Resources Institute Finland

Conservation

The principles on which the work on forest genetic resources was founded have proven to be sound and sustainable. Using *in situ* and *ex situ* methods for different species of trees, based on their characters, has been a cost-effective exercise. The concept 'gene reserve forest' as adopted by Finland in the 1990s has become firmly established in Europe as the minimum requirements for an *in situ* conservation unit, which are the outcome of wide-ranging negotiations, closely resemble the requirements for a gene reserve forest in the Finnish programme. The diversity of rare tree species cannot be conserved in gene reserve forests because no large enough natural stands occur. For these species, *ex situ* conservation in collections of living trees has proven to be a good approach. Unlike the conservation of seeds in cold storage or cryopreservation of tissues, it allows the species to adapt to climate change, which is why the method is termed dynamic *ex situ* conservation. However, cryopreservation is needed for some species seriously threatened by diseases.

An essential part of the conservation and sustainable use of genetic resources is information management, which takes place centrally in the forest genetic resources register at the Natural Resources Institute Finland. The forest genetic resources register is closely connected to the Finnish Food Authority's data system on forest reproduction material and the European Information System on Forest Genetic Resources (EUFGIS).

Natural Resources Institute Finland implements the programme on forest genetic resources and participates in wide-ranging international collaboration by request from the Ministry of Agriculture and Forestry. Natural Resources Institute Finland does not possess any land, which is why all gene reserve forest and genetic resource collections that are located on government land are administered by Metsähallitus. Their management plans are approved at the Natural Resources Institute Finland. Metsähallitus carries out management work in the gene resource forests on state land and Natural Resources Institute Finland maintains the genetic resource collections. The potential extra costs arising out of the special management of gene reserve forests are taken into account when setting the financial goals for Metsähallitus. No compensation is paid for gene reserve forests located on privately owned land and no legally binding agreements are made.

Sustainable use and accessibility

The Finnish legislation on forests is based on the principle of sustainable forestry, which consists of three equally important areas: ecological, social and financial sustainability. The forest genetic resources form the basis for sustainable forestry, as well as for environmental diversity and multiple use forests.



Photo 3. Genetic resource collections of noble hardwoods have been established with material collected from natural forests. The oak trees growing at Lenholma, Parainen have six offspring in the collection 182 at Raasepori. Photo by Erkki Oksanen, Natural Resources Institute Finland

The Forest Act contains provisions on the mandatory regeneration of forests and specifies the tree species that can be used in the regeneration. The trade in forest reproductive material is also regulated, to ensure that the purchaser has correct and appropriate information on which to base the purchase decision. The control of trade plays a part in the sustainable management of genetic diversity, for example by regulating the composition of seed orchards and the use of clones in forest cultivation.

Forest tree breeding is an essential part of the seed supply of forest trees, and it secures the availability of genetically high-quality and diverse seeds for forest regeneration throughout Finland. The work on forest genetic resources supports forest tree breeding and ensures that the original material is conserved in the gene reserve forests in a sample-like fashion, while the bred material is used for regeneration of the economically most significant tree species. The genetic resource collections of rare tree species will in the future produce genetically diverse seeds for forest regeneration. Furthermore, the collections will offer material for breeding in circumstances where the climate is becoming more favourable for the currently rare deciduous trees.

Research

The funding of the programme on genetic resources is not sufficient for conducting research, but there are both national and international projects concentrating on research on the conservation of genetic resources and the scope of conservation in the changing climate. Several international projects have investigated the overall state of conservation in Europe and seek to identify species and areas that need particular action. National projects commonly study the extent of the national conservation network and the characteristics of genetic variation at the northern edge of the distribution area. It is also important to collect species-specific basic information on genetic variation that can be used for determining the optimum composition of collections. Some research needs are very practical. Conservation techniques still need further development, and the work on the genetic resources of forest trees lags behind the other sectors in the utilization of cryopreservation. At present, the process of tissue conservation at low temperature and the associated vegetative reproduction in a laboratory is available for only a few tree species.

Climate change poses significant challenges for the work on genetic resources. One of the most important future needs is research on accelerated adaptation: short rotation forests and experiments on rapid evolution that utilize seeds from gene reserve forests. This is also associated with the use of assisted migration in supporting adaptation to climate change. Due to the increasing occurrence of forest damage, joint research is needed on genetics, pathology and forest zoology. It must also be borne in mind that the list of tree species growing in Finland and utilized in forestry will change, and also the new potential species have to be included in research programmes.

3.3 Animal genetic resources

Current state and priorities

In the National Genetic Resource Programme following animal species are considered: horse (*Equus caballus*), chicken (*Gallus gallus domesticus*), dog (*Canis lupus familiaris*), sheep (*Ovis aries*), bee (*Apis mellifera*), cattle (*Bos taurus*), reindeer (*Rangifer tarandus*), pig (*Sus scrofa*) and goat (*Capra hircus*). The National Genetic Resources Programme covers both indigenous breeds and imported breeds that have a long breeding history in Finland.

The National Genetic Resources Programme aims at securing the current national animal genetic resources for future use in agriculture, food production and other societal purposes. Diversity in animal genetic resources is an absolute prerequisite for the breeding of farm animals and associated research and development. The genetic differences between breeds and individuals in a species represent the most important resource for developing the traits of animals through breeding and cross-breeding.

The objectives of the programme are:

1. The indigenous breeds do not become extinct and their genetic resources are conserved
2. Indigenous breeds are maintained in an economically sustainable way
3. Genetic variation remains as large as possible in domestic animal breeds
4. Breeding programmes develop the production, health and other important traits of domestic animals in a balanced way
5. Expertise and knowledge associated with the genetic resources of farm animals is maintained and developed

The most important regulations and strategies

The national work on animal genetic resources is based on two earlier committee and working group reports: the Committee report on animal genetic resources (Committee report 1983: 76) and the Finnish national animal genetic resources programme published in 2004 (MOAF publications 17/2004).

The Act on Genetic Resources (HE 126/2015) implements the Nagoya protocol that supplements the UN Rio Convention. The Act contains provisions on the availability of genetic resources and the fair distribution of benefits arising from them. The Act regulates the use of genetic material for research and development purposes when the material is transferred from one country to another. Finland does not regulate the availability of

its animal genetic resources, but Finnish researchers must follow the regulations of the country of origin of the genetic resources.

The planning and implementation of the Finnish National Genetic Resource Programme follows the FAO Global Plan of Action for Animal Genetic Resources (FAO 2001), which has four priority areas: 1) analysis and inventory of animal genetic resources, 2) sustainable use, 3) conservation and 4) policies, institutions and capacity building associated with animal genetic resources.

Conservation

Animal genetic resources are conserved both *in vivo* and *in vitro*. *In vivo* means the maintenance of animal genetic resources by breeding or conserving live animal populations. A subsidy for raising indigenous breeds is available for *in vivo* conservation of indigenous breeds. The subsidy is available as a special subsidy under environmental subsidies. Living genebanks have been established for indigenous breeds. The Pello prison farm raises Northern Finncattle, Finnsheep and Kainuu Grey sheep. The Vocational College of Kainuu keeps Eastern Finncattle and Ahlman Vocational College keeps Western and Eastern Finncattle. A network of hobby breeders has been established to conserve the Finnish landrace chicken.

In vitro methods include the freezing of semen, oocytes and embryos in liquid nitrogen. Other tissues, such as blood and muscle, or the macromolecules that carry genetic information (DNA and RNA) can also be frozen. The programme contains guidelines on the quantity of semen doses and embryos to be frozen. The collection operations and freezing methods for genetic material from many farm animal species still need development.



Photo 4. Finland has three indigenous cattle breeds: Eastern Finncattle, Western Finncattle and Northern Finncattle. Eastern and Northern Finncattle were about to become extinct in the 1980s, but were saved thanks to active conservation measures. Photo by Kirsi Hassinen

Sustainable use and accessibility

Animal genetic resources and the associated genetic information are needed in breeding and in the R&D on farm animal breeding. Finland's national animal breeding programmes are usually sustainable and take into account not only production characters but also properties associated with the animals' conformation, health, fertility and longevity. The programmes also strive to avoid inbreeding.

The *in vivo* animal genetic resources in Finland are mostly owned by private persons, but also the state of Finland, other public sector organizations such as colleges, as well as breeding organizations and associations. Utilizing animal genetic resources in breeding, research and development usually requires an agreement on the transfer of genetic resources between the owner and the user.

The *in vitro* animal genetic resources collected under the national programme are owned by the state of Finland, except for the *in vitro* genebanks for indigenous dog breeds and most cattle breeds, which are owned by the Finnish Kennel Club and Viking Genetics, respectively. The utilization of the *in vitro* genetic resources owned by the state of Finland

is the responsibility of Natural Resources Institute Finland, which also coordinates the animal genetic resources sector of the national programme.

Research

Research on animal genetic resources is conducted in the Natural Resources Institute Finland, universities, research institutions and universities of applied sciences. Natural Resources Institute Finland promotes the research of all farm animals and breeds that belong to the national programme. The aim is to carry out multidisciplinary research to gain an understanding of the genetic, breeding, social and cultural values of animal genetic resources. Traditional knowledge on animal breeds is also collected. Another important area is to conduct research that supports branding of products of the native breeds because it helps to conserve the breeds. Natural Resources Institute Finland carries out research to develop *in vitro* methods for animal genetic resources and animal breeding programmes, which promotes the conservation and utilization of animal genetic resources.

3.4 Fish genetic resources

Current state and priorities

The decline of fish populations due to environmental changes and human activity necessitates increasing efforts to conserve fish genetic resources. The EU Nature Directive requires that the genetic resources of certain species of fish considered important by the community be monitored and conserved. Likewise, when a species is classified as endangered in a national endangerment assessment, it obligates the state to take action to conserve the genetic resources of the species.

The Ministry of Agriculture and Forestry is responsible for conserving and managing the 31 economically important fish species in Finland. The conservation of these species is implemented by fishing regulation, fish stock management and the state's aquaculture activities, but the survival of fish species and populations is strongly affected by the state of their habitats and changes taking place therein. Other species of fish are covered by the Nature Conservation Act and their conservation is the responsibility of the Ministry of the Environment. The objective of protecting several species is to conserve a sufficient amount of genetic resources in nature whenever possible. The state's aquaculture operations protect genetic resources, linking the operations directly to the obligations arising out of both national and international endangerment assessments.

The fish genetic resources programme covers the most endangered and financially important fish species and populations. This means species and populations whose genetic resources are not sufficiently secure in the wild as far as their diversity or length of survival is concerned, and on the other hand the fish and crayfish species which could potentially be economically important, either in the wild or in cultivation. In practice, the programme applies to the 11 economically most significant species or varieties of fish.

The most important regulations and strategies

The maintenance of the genebank for broodstock and milt bank is based on the Act on Natural Resources Institute Finland dated 27 June 2014 (561/2014), the government decree issued on 4 September 2014 (715/2014) and on the performance agreement between the Ministry of Agriculture and Forestry of Finland and the Natural Resources Institute Finland. The new Fishing Act (379/2015) is a response to the changes that have occurred in fishing, national and EU legislation and in society in general. By way of exception, section 37 of the Nature Conservation Act (1096/1996), concerning the protection of animal species, does not apply to commercially exploited fish species. These 31 species are defined in the Act, and their use and conservation is the responsibility of the Ministry of Agriculture and Forestry.

The fisheries administration strategy 2014–2018 seeks to make the use of fishery resources ecologically, financially and socially sustainable. The key idea in the strategy is that the fisheries administration secures the viability of the fish stocks, promotes sustainable use of fishery resources in collaboration with the stakeholders in the sector and creates the conditions for business and recreational fishing based on fishery resources. The national fish pass strategy seeks to strengthen the viability of vulnerable and endangered stocks of migratory fish in their natural habitats.

According to the 2010 Red List of Finnish Species, sea trout, sea grayling, landlocked salmon and Arctic char of the Lake Saimaa region are critically endangered species; Baltic whitefish, eel and the inland brown trout populations south of the Arctic Circle are endangered species, and of economically viable fish, two forms of whitefish (*Coregonus lavaretus pallasi* and *Coregonus lavaretus widegreni*) and Baltic and Atlantic salmon are considered vulnerable species. Strategies and action plans have been created for some fish species (landlocked salmon, Arctic char of the Lake Saimaa region, sea trout, sea spawning grayling, eel, crayfish, salmon and the brown trout and grayling of the Vuoksi water body).

Conservation

The primary objective of the fish genetic resources programme is to conserve and strengthen the viability of indigenous wild fish species and their stocks and, when necessary, secure the conservation and availability of stock material by means of fish rearing, broodstock and a milt bank. The fish genetic resources programme secures and develops the use of domestic and imported fish as edible fish and restocking material.



Photo 5. The eggs of whitefish (*Coregonus lavaretus fera*) are harvested for hatching and rearing in a natural food pond. Photo by Petri Heinimaa, Natural Resources Institute Finland

The shoals of broodstock must be established from a sufficient number of brood fish captured in the wild (the goal is to have more than 50 spawning pairs). Furthermore, the broodstock shoals must be replenished or renewed at least once in the lifetime of a generation of fish. The rearing must use several parallel shoals of broodstock from different origins and the shoals must not be pared down during rearing. For each species and population, egg production must continuously use at least two broodstock shoals of genetically different backgrounds to ensure diversity and avoid too high a degree of relatedness in the offspring. If the genetic background of the fish stock is narrow and the production quantities are small, the parent fish must be labelled individually and molecular genetic methods must be used to control inbreeding risks.

Ensuring the conservation of genetic material stored in a milt bank requires backed up cryogenic storage in liquid nitrogen. The genetic material is currently stored at two

separate physical locations. The quantities of frozen milt are determined on the basis of the need to broaden the genetic diversity of the broodstock shoal. Therefore, milt is sold as fresh milt obtained from the males from the living genebank. In special cases, the milt can be delivered frozen.

Sustainable use and accessibility

The fish genetic resources programme guides and aligns the monitoring, research and cultivation operations carried out by Natural Resources Institute Finland to conserve the genetic diversity of economically important fish stocks. The objective is to ensure that the genetic diversity of economically important fish and crayfish is permanently conserved and is large enough to ensure their viability and commercial exploitation. This should be achieved by using methods that are in harmony with the requirements for conserving the species. This task requires that the genetic resources of important fish populations in the wild be monitored and managed and that species-specific management strategies be created and implemented. As a rule, the monitoring covers all commercially viable fish and crayfish species. Active management measures are required when the natural resources of the species weaken and the species should not and cannot be utilized any more. In the first phase, various regulatory and recovery measures are taken to improve the state of the fish stocks in the wild. If this fails, the next step is artificial reproduction using genebanks, which consists of the procurement and rearing of natural fish eggs or production of fish eggs by establishing broodstocks.

The genetic resources maintained on the fish farms of the Natural Resources Institute Finland are widely used for securing and enhancing the reproduction of wild and reared fish stocks. Bred material is also used in the production of edible fish. Reared material is delivered for a fee to both domestic and foreign organizations. Fish genetic resources are used in research in collaboration with different research institutions and universities.

The management of fish stocks is increasingly moving towards supporting the wild stock by improving its habitats, removing obstacles to migration, regulating fishing and transferring natural fish to spawning areas. The new Fishing Act and Decree create better conditions for appropriate management and utilization of fish stocks. In the future, restocking operations will increasingly support either fish stock natural cycles in the wild or targeted restocking of fish stocks intended for fishing, especially in bodies of water that do not have the conditions that support natural reproduction of the species.

The selective breeding programme of fish must be continued to ensure a constantly improving supply of better rearing material for business purposes.

Research

National research on the conservation of the genetic resources of fish stocks in the wild will be conducted in collaboration with the stakeholders of the Finnish fishing industry. Genetic information is needed and used regularly for the prioritization of fish stocks to be conserved, creation of conservation strategies and action plans that seek to maximize the conservation of diversity, investigating the origin and authenticity of fish stocks, monitoring the conservation of genetic diversity, identifying fish stocks and individual specimens, planning of fishing regulations and fish farming, taking in to account the objectives laid down in the Fishing Act on knowledge-based maintenance and utilization of fish stocks.

Research can determine, for example, the genetic structure of the populations, the extent of genetic diversity, the degree of differentiation, origin, genetically effective size and degree of relatedness. Natural Resources Institute Finland currently has a national standard set of DNA microsatellites for 15 genetic loci in nine species of fish: salmon, sea and brown trout, char, whitefish, vendace, grayling, sheefish (*Stenodus leucichthys*), rainbow trout and zander.

4 COMMUNICATIONS

Communication is an important part of the work on genetic resources, but its focus varies from sector to sector. The current forms and channels of communication have worked well, and we intend to continue using them.

The purpose of social communications is to increase public awareness of the importance and utilization opportunities for genetic resources and genetic diversity and also ensure that the opportunities afforded by genetic resources are fully utilized through political control. Communications targeted at stakeholders seem to find key partners and support organizations whose core expertise aligns with the work on genetic resources.

Social communications consists of Geenivarat [Genetic Resources] newsletter as well as bulletins, brochures and guidelines published on the Natural Resources Institute Finland website. We have also produced educational materials, for example on the Pedanet platform. Electronic materials involve a duty to keep them up-to-date, which is taken into account when making decisions on new tools. The animal genetic resources programme has good experience of using Facebook for communications, and we should consider adopting this channel for other sectors as well. Social media channels will be used with discretion and in a planned way, taking into account our limited resources. It is also possible to set up a separate website concerning the genetic resources in Finnish agriculture and forestry.

General awareness of genetic resources will be increased by maintaining the opportunity of the general public to learn about plant genetic resources and animal landraces in demonstration parks. Other means are, for example, adding educational signs on *in situ* conservation sites. The development of genetic resource parks and demonstration areas promotes the utilization of genetic resources in, for example, tourism. The forestry sector must pay particular attention to ensuring that people understand the conservation methods for genetic resources also from the perspective of nature conservation. Backup arrangements will be created for crisis communications.

Interaction and communication with the primary stakeholders will take place through face-to-face communication. For example, the owners of gene reserve forests, keepers of indigenous livestock and maintainers of reserve collections will be supported by meeting them and organizing targeted seminars. Personal and small-group communications motivate the parties and also provide an opportunity to verify that their operations are in line with our strategy and instructions. Furthermore, virtual meeting locations targeted at specific groups (websites, databases serving the general public, guidelines and educational materials) play an important role in our collaboration with stakeholders. Publications created from seminars and workshops serve the conservation efforts for a long time after the event itself has ended.

National genetic resources programmes work actively in the Nordic and international genetic resources networks, participating in workshops, seminars, joint research and communications. They are arenas in which our strong expertise on genetic resources can be increasingly displayed. International networks and organizations communicate on genetic resources on their own websites and other forums in accordance with their own communications strategies. These organizations engage in significant goal-oriented communications at a political level (EU) and collaborate with many other international organizations. Their websites are read widely also by people outside the genetic resources sector. Both NordGen and European networks (ECPGR, EUFORGEN, ERFP) publish news from the member states on their websites. We also intend to publish information on the activities of these international organizations on our national forums in Finland.

Reports of the work on genetic resources are regularly published on international forums. The most important reports are the follow-up reports on the Global Plan of Action submitted to FAO by many sectors, and the State of the World reports. The forest sector reports the actualisation of the FOREST EUROPE commitments that concern genetic resources and the associated indicator.

5 ORGANIZATION OF THE WORK ON NATIONAL GENETIC RESOURCES

Advisory board on genetic resources

An advisory board on genetic resources acts as the MOAF expert body in the preparation of matters associated with the conservation and sustainable use of genetic resources. The board contains representatives from various ministries, research institutions, educational institutions, authorities and breeding organizations, businesses and associations. The Åland Island government is also represented on the board. However, the board does not have any executive powers.

The task of the advisory board is to participate in the preparation of legislation on the conservation and sustainable use of genetic resources for agriculture, forestry and fisheries, to prepare matters associated with national genetic resources programmes on agriculture and forestry as well as monitor and develop the programmes. It acts as the cooperative body between ministries in matters associated with genetic resources for agriculture and forestry and publishes information on the conservation and sustainable use of genetic resources for agriculture and forestry.

Natural Resources Institute Finland

In accordance with the Act on Natural Resources Institute Finland (561/2014), Natural Resources Institute Finland performs tasks associated with the conservation of diversity in genetic resources. Natural Resources Institute Finland acts as the coordinator for the entire genetic resources sector and maintains the majority of genetic resources collections that belong to the national genetic resources programme. Natural Resources Institute Finland also collaborates widely with stakeholders associated with the maintenance and sustainable use of genetic resources.

6 RESOURCES OF THE GENETIC RESOURCES PROGRAMMES

The government framework decisions and state budget allocates funds for the implementation of the genetic resources programmes, and these funds are used to allocate resources for the conservation of genetic resources and fund other primary operations. Furthermore, we actively seek funding for projects and research that promotes the conservation, maintenance and development of genetic resources.

Long-term commitment is of paramount importance in the work on genetic resources: staff, sites, equipment and land areas are needed for several decades into the future. Another critical factor is the management of the expertise of the staff and ensuring that it is transferred even during periods of change.

The core of the work on genetic resources, i.e. coordination, long-term conservation and associated research on methodologies is funded publicly. The coordination consists of both coordination of practical conservation methods and engaging in international collaboration. This ensures the continuity of operations, based on which we can build research and income generation. For project-like development and research efforts, we seek funding from domestic sources and the EU.

Natural Resources Institute Finland maintains a national genetic resource collection of vegetatively reproducing cultivated plants. The identification information for plant stocks is stored in a genebank database and the availability of the material is arranged as required by international agreements. It is critical that the development of the maintenance of national collections and the operations of the genebank can continue far into the future. Cryopreservation plays a significant role as a backup storage for vegetatively reproducing plant species, and the continuity of its maintenance and development must be ensured. Furthermore, the *in situ* maintenance of genetic resource stocks must be possible also in the future through rural development subsidies. We are increasingly searching for external research funding for public notices, characterization and evaluation of plant genetic resources. A new operating area will be the conservation

of the wild relatives of cultivated plants in Finland, which will require collaboration across administrative branches in terms of content and funding.

The work on genetic resources of forest trees requires long-term resourcing for the set-up and maintenance of collections (labour costs and materials) and the maintenance of the network of gene resource forests (emphasis on labour costs). The long-term conservation of genetic reserve forests requires that Metsähallitus participate in the maintenance of the network of genetic reserve forests. When it comes to collections of living trees, the focus will move from setting up a collection to maintaining it. At the same time cryopreservation will be introduced, which will require a corresponding change in resourcing. However, collections will be established until a backup collection (a copy of the original) is established. Initiating cryopreservation will need extra resources for a short time during the years the material is deposited, but the maintenance of the material stored in the cryogenic tank will not represent a significant extra cost. The characterization of the genetic resource collections by means of molecular genetics requires project funding with a research component.

The work on animal genetic resources will involve collaboration with farms owned by public administrations. In addition to securing funding and infrastructure for coordinating, collecting the frozen genetic material and developing the use of genetic resources and associated expertise, it is also critical to ensure the continuity of the operations of the parties that maintain these essential living populations. Subsidy policy must be developed to correspond with the current costs incurred by keeping livestock.

In fish genetic resource work, public funding is justified for basic operation of the milt bank and the conservation operations and research on fish genetic resources. Some operations in fish genetic resources work can be funded by marketing the genetic resource products (fish eggs and fry).

Publications of the Ministry of Agriculture and Forestry 2020

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- 2 Tenon kalastussopimuksen vaikutukset - sopimuksen toimivuuden arviointi eri osapuolten näkökulmasta**
- 3 Laxregale och fiskerättigheter enligt särskilda grunder i norra Finland - nuläge och bedömning av eventuella behov av ändringar**
- 4 Maa- ja metsätalousministeriön kirjanpitoyksikön tilinpäätös vuodelta 2019**

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